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Planck intermediate results: XXV. the Andromeda galaxy as seen by Planck

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Abstract

© ESO 2015. The Andromeda galaxy (M 31) is one of a few galaxies that has sufficient angular size on the sky to be resolved by the Planck satellite. Planck has detected M 31 in all of its frequency bands, and has mapped out the dust emission with the High Frequency Instrument, clearly resolving multiple spiralarms and sub-features. We examine the morphology of this long-wavelength dust emission as seen by Planck, including a study of its outermost spiral arms, and investigate the dust heating mechanism across M 31. We find that dust dominating the longer wavelength emission (≥ 0.3 mm) is heated by the diffuse stellar population (as traced by 3.6 μm emission), with the dust dominating the shorter wavelength emission heated by a mix of the old stellar population and star-forming regions (as traced by 24 μm emission). We also fit spectral energy distributions for individual 5′ pixels and quantify the dust properties across the galaxy, taking into account these different heating mechanisms, finding that there is a linear decrease in temperature with galactocentric distance for dust heated by the old stellar population, as would be expected, with temperatures ranging from around 22 K in the nucleus to 14 K outside of the 10 kpc ring. Finally, we measure the integrated spectrum of the whole galaxy, which we find to be well-fitted with a global dust temperature of (18.2 ± 1.0) K with a spectral index of 1.62 ± 0.11 (assuming a single modified blackbody), and a significant amount of free-free emission at intermediate frequencies of 20-60 GHz, which corresponds to a star formation rate of around 0.12 M⊙ yr-1. We find a 2.3σ detection of the presence of spinning dust emission, with a 30 GHz amplitude of 0.7 ± 0.3 Jy, which is in line with expectations from our Galaxy.

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Keywords

Galaxies: individual: Messier 31, Galaxies: ISM, Galaxies: structure, Radio continuum: galaxies, Submillimeter: galaxies